Use of GLIF to Model a Behavioral Intervention

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Abstract:
As a first step towards creating an ontology describing behavioral interventions, we created an ontology of PACE-Adolescent, a theory-based behavioral intervention, using PROTÉGÉ-2000 and GLIF3. In the ontology, we were able to describe the overall behavioral protocol using GLIF3, adding additional ontology components to describe counseling actions, to enumerate behavioral theory constructs, and to link actions to constructs. We hope to work towards facilitating formal analysis of behavioral interventions and reuse and retesting of their components.

Our society suffers from an increasing prevalence of lifestyle-related chronic diseases (e.g. diabetes, cardiovascular disease). To meet this challenge more theoretically-grounded research into methods for promoting positive behavioral change is needed. While compelling theories of change exist, development of health behavioral interventions from a theoretical frameworks, such as the Transtheoretical Model (1), has typically used an ad hoc approach, moving directly from the theory to the incorporation of lemmas and principles into interventions in a 'one-of-a-kind' fashion. Such an approach does not lend itself to understanding of the impacts of the components of interventions. It also hampers the dissemination of work by obfuscating what is generalizable from one domain to another. We propose that the approach to creation of theoretically grounded interventions evolve to include the intermediate step of formal representation of the theoretical models, the interventions, and the relationships between such in an intervention protocol using an ontology.

In order to explore what such an ontology might look like, we developed the PACE-Adolescent ontology, describing PACE-Adolescent, an intervention that takes youth through an intensive two-year counseling program. Subjects are initially assigned a "stage" for each of four behaviors relating to physical activity and nutrition based on their readiness to meet the target behavioral goal for each of these behaviors. Stages are based on the "Stages of Change" (Transtheoretical) Model. Individuals, for example, who are in the "Precontemplation" stage require different interventions than persons in later stages.

We modeled PACE-Adolescent using PROTÉGÉ-2000, an ontology and knowledge base authoring tool.

The ontology was developed iteratively with feedback from content experts and experienced ontology developers. Information about PACE-Adolescent was collected through staff interviews, review of materials and design specifications, and observation of counseling procedures. Issues considered during modeling included reusability of components, flexibility, generalizability to other behavior protocols, and linkage to behavior theory.

The finished ontology contained three key components. The first provided a way to describe intervention actions in terms of the people participating, the resources used, and the theoretical constructs involved. The second served to describe behavioral theories, giving a comprehensive list of the constructs involved in each. The third and final component described the structure and sequence of actions using the framework elaborated in the Guideline Interchange Format, version 3 (GLIF3) (2).

Parts of GLIF3 that were not used, but that may be helpful in the future, include GLIF3's representation of time and its ability to capture data and concepts. One limitation of GLIF3 was the absence of a way to link actions to theoretical constructs (such as self-efficacy). Second limitation was the absence of concepts needed to describe actions in a behavioral intervention. To meet these needs, we extended GLIF3, adding a new subclass of Action_Step, entitled Pace_Action, that contained slots to link information about the actors (e.g. Research Assistant, Participants), resources (for example a. Self-efficacy Worksheet) and constructs (e.g. Self-efficacy) actions in the PACE protocol.

Future work will include testing of the generalizability of our ontology by using it to encode other behavioral interventions. GLIF3 was useful for modeling the structure of the behavior protocol, and may be useful for other domains as well.

References

(1) Prochaska JO. *Systems of Psychotherapy: A Transtheoretical Analysis*. (2nd ed.) Pacific Grove, Calif: Brooks-Cole, 1984. (Originally published 1979.)

(2) Zeng Q., Tu S., Boxwala A., Peleg M., Greenes RA, and Shortliffe EH, A Three-Layer Domain Ontology for Guideline Representation and Sharing. Proc AMIA Symp 2000.